T04D02 – (4.2a) Covalent Bonding

Name………………………………………………….

1. 4.2.1 Describe the covalent bond as the electrostatic attraction between a pair of electrons and positively charged nuclei. (2)
   a. Define a Covalent Bond:

   b. Illustrate how the size of the atoms in a covalent bond can affect the relative attraction to electrons and hence the polarity of a bond:

2. 4.2.2 Describe how the covalent bond is formed as a result of electron sharing. (2)
   a. In a single bond, each atom contributes one electron (unless dative) to the shared pair.
   b. Each atom then achieves noble gas configuration
   c. Covalent bonds are formed between what elements, what is the result called?

   d. What is a diatomic molecule?

   e. Illustrate multiple ways of representing the bonds in H_2, Cl_2 and O_2:

   f. Draw the lewis dot structure for H_2O, CO_2 and N_2:

   g. What are the octet and duet rules?

      i. Give two examples of compounds that have an **incomplete octet**:

      ii. Give three examples of compounds that have an **expanded octet:**

   h. Define the **valency** of elements

H 1																	He
Li 1	Be 2											B 3	C 4	N 3	O 2	F 1	Ne
Na 1	Mg 2											Al 3	Si 4	P 3/5	S 2/4/6	Cl 1	Ar
K 1	Ca 2	Sc 3	Ti 4	V 3/4/5	Cr 3/6	Mn 2/4/7	Fe 2/3	Co 2	Ni 2	Cu 1/2	Zn 2					Br 1	Kr
Rb 1	Sr 2									Ag 1			Sn 2/4			I 1	Xe 6
Cs 1	Ba 2												Pb 2/4				

i. Describe and illustrate what a **free radical** is:

j. Describe what a coordinate covalent compound is. Illustrate a coordinate covalent bond and state what their bonds are called:

3. 4.2.3 Deduce the Lewis (electron dot) structures of molecules and ions for up to four electron pairs on each atom. (3)
   a. List the general rules for drawing lewis dot structures:
      i.
      ii.
      iii.
      iv.
      v.
   b. The NAS rule can be used to determine the number of bonds in a molecule and help to find double and triple bonds. Explain the rule, and use it to determine the bonds in CN^-, SO_4^{2-} and NH_3:
   c. What is formal charge and how can it be determined? What does it help to find?
      i. Use the formal charge to determine the proper placement of the double bond in CSO_2^{2-}:

4. 4.2.4 State and explain the relationship between the number of bonds, bond length and bond strength. (3)
   a. What is the relationship between bond strength and bond length. Explain how they are related:

The remainder will be covered in the next two classes:

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5. 4.2.5 Predict whether a compound of two elements would be covalent from the position of the elements in the periodic table or from their electronegativity values. (3)
    a. ON IONIC NOTES
6. 4.2.6 Predict the relative polarity of bonds from electronegativity values. (3)
    a. When will a BOND be non-polar:
    b. When will a BOND be polar:
    c. When will a BOND be ionic:
    d. Explain, using a diagram and your own words, how ionic character increases as the bonding changes, even if the bond is not considered to be ionic:
7. 4.2.7 Predict the shape and bond angles for species with four, three and two negative charge centres on the central atom
   using the valence shell electron pair repulsion theory (VSEPR). (3)
    a. State the VSEPR Theory and what it means:
    b. Use the structures of CH_4, NH_3, and H_2O to describe the repulsions of electrons in bonds:
    c. Draw and label each of the general shapes when there are between two and six charged centers surrounding the central atom:

Charged Centers:	**General Diagram:**	**Examples using various lone pairs:**	**Bond Angles:**	**Name:**
2				
3				
4				
5				
6				

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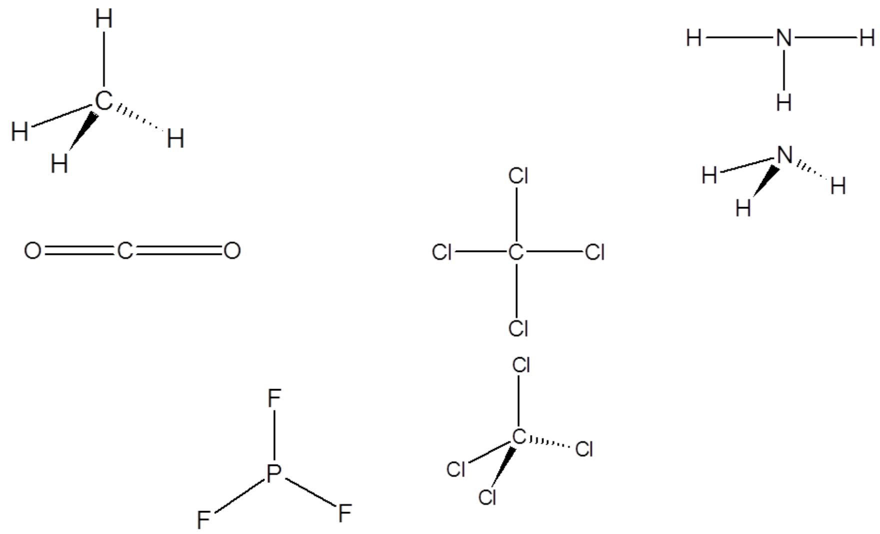
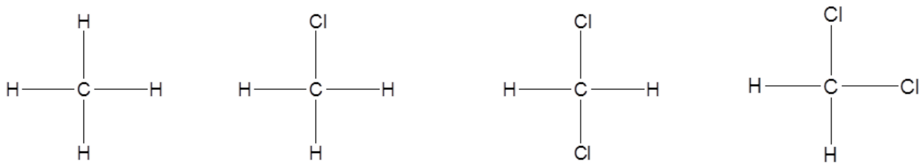
8. 4.2.8 Predict whether or not a molecule is polar from its molecular shape and bond polarities. (3)
   a. Bond polarity and molecule polarity are determined by two different methods.
      i. How is bond polarity measured? Use the diatomics and HCl as an example:

      ii. How is molecule polarity measured? Use CH_4, CO_2, PF_3, CCl_4, and NH_3 as examples:



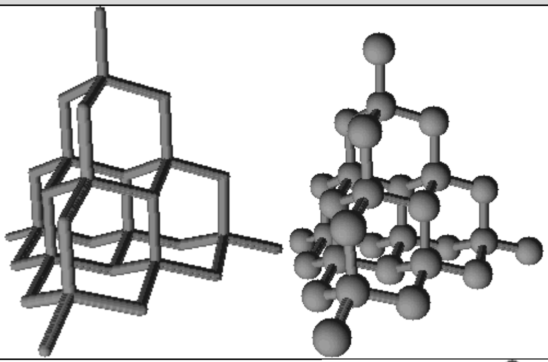
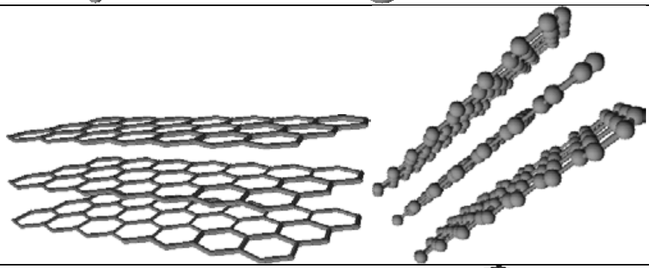
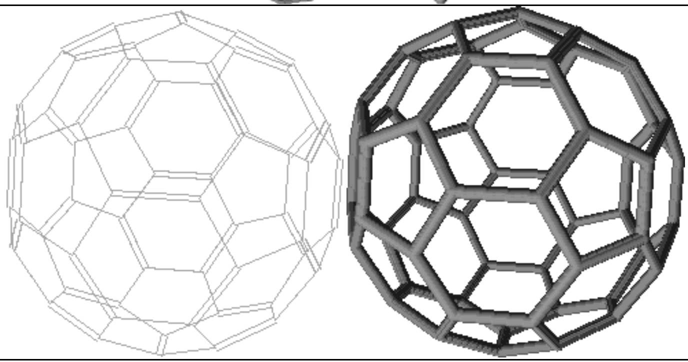
      iii. When determining the polarity of tetrahedral structures you must use care. Using the following examples, first illustrate a 3-D model and label the dipoles for polarity, then determine the shapes polarity:



9. 4.2.9 Describe and compare the structure and bonding in the three allotropes of carbon (diamond, graphite and C60 fullerene). (3)
   a. Complete the following table with a list of properties for the common allotropes of carbon

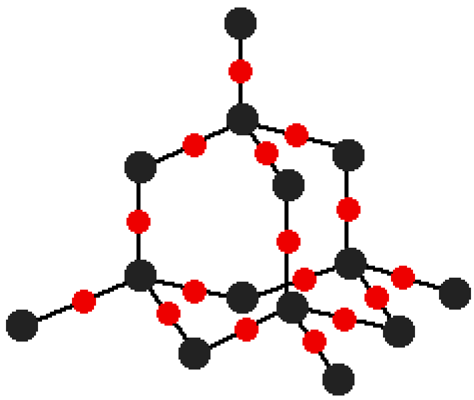
Allotrope	Diamond	Graphite	Carbon C-60
Color			
Hardness			
Electrical Conductivity			
Density (g cm^{-3})			
Melting Point (K)			
Boiling Point (K)			

b. For each of the following allotropes, describe the bonding that occurs (be as specific as possible):

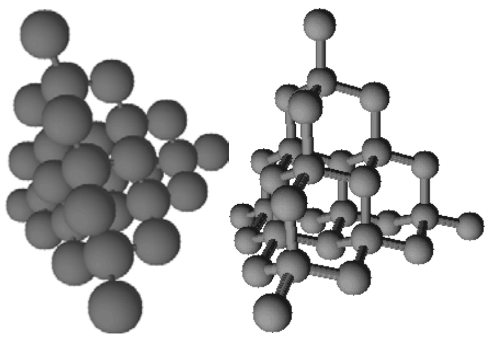
Allotrope	**Diagram/Structural Formula**	**Description of bonding**
Diamond		
Graphite		
Fullerene		

10. 4.2.10 Describe the structure of and bonding in silicon and silicon dioxide. (2)

a. Describe the bonding that results in silicon dioxide:



b. Describe the bonding that results in silcon:



Silicon vs Diamond